DETERMINATION OF LEAD ION IN BODY CREAM SAMPLES USING SILVER NANOPARTICLES AND DITHIZONE AS A SENSOR

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ABSTRACT

Lead is one of the most toxic heavy metals causing harmful effects on human body such as miscarriages, reduced fertility in men and women Therefore it is necessary to detect its presence in body cream samples. Different methods have been employed to detect the presence of lead ion in body cream samples such as Atomic Absorption Spectrometry, Inductively Coupled Plasma Atomic Emission Spectrometry and X-ray Fluorescence. However, these methods suffer high costs, time consuming, sophisticated instruments and technical expertise. This study developed a sensitive indicator to detect lead ions in body creams using a colorimetric method with an organic colorimetric reagent, Dithizone (DTZ) and silver nanoparticles (AgNps). The AgNPs and DTZ/AgNPs were characterized using Scanning Electron Microscpe (SEM), X-ray Crystallography (XRD), Ultraviolet/Visible Spectroscopy (UV- Vis) and Fourier-transform infrared spectroscopy (FTIR). The indicator was prepared by dissolving 0.03 g of silver nanoparticles (AgNPs) in 20 ppm DTZ solution at pH 7 which gave an optimal performance and highest detection efficiency. Batch experiments were carried out at different concentrations of aqueous Pb^{2+} solutions to obtain optimal conditions under which the indicator would operate. The prepared indicator was applied on 10 cream samples collected randomly within Ladega market in Ikorodu, Lagos. The SEM image showed aclustering of the particles in AgNps having spherical shape. XRD showed a diffraction peak observed at 2θ corresponding to that of face centered cubic crystal system while the UV-Vis spectral of AgNPs showed a maximum absorption peak at 418 nm. The FTIR spectrum of AgNPs showed a peak at 2329cm^{-1} which is indicative of OH stretch of the hydroxyl group. The UV-Vis spectrum of DTZ showed maximum absorption around 599 nm while that of DTZ/AgNPs was around 488 nm, indicating a blue shift due to the interaction of sulphur atom with Ag atom. The FTIR spectrum of

DTZ/AgNPs showed that silver exhibited affinity towards nitrogen and sulphur as indicated by the shift in IR stretching frequencies of (2329 cm^{-1} - 3317.3 cm^{-1}). It was observed that the determination of Pb^{2+} was based on the decrease of the colour intensity (from light orange to colourless) of DTZ/AgNPs with increase in Pb^{2+} concentration in the solution. Re-oxidation of Pb^{2+} to colourless using DTZ/AgNPs indicated the most significant sensitivity. The detection of Pb^{2+} from the cream samples showed that all the ten cream samples contained lead with concentrations ranging from below detection limit (BDL) to 24.8 mg/L. The indicator worked best between 0 and 5 mg/L. and had limit of detection and limit of quantification at 0.47 and 1.5 mg/L respectively. This study showed that the indicator developed detected lead in body creams.